CHRISTMAS MOUNTAINS RESEARCH SYMPOSIUM

2025

Terlingua Ranch Lodge
Brewster County, Texas
May 18–20, 2025

CHRISTMAS
MOUNTAINS
THE TEXAS STATE UNIVERSITY SYSTEM

Sponsored by the Texas State University System, the TSUS Foundation,
and the Texas State University Department of Biology

2025 CHRISTMAS MOUNTAINS RESEARCH SYMPOSIUM

Terlingua Ranch Lodge
Brewster County, Texas
May 18–20, 2025

Sunday, May 18th

5:30 pm Informal social for meeting participants on the patio by the café

6:30 pm Dinner for meeting registrants at the Bad Rabbit Café (meal available for attendees who did not preregister, $30.00)

Monday, May 19th

8:00 am Field trip to Christmas Mountains overlook (meet in the parking lot outside the bunkhouse)

8:00 am Paleontology and geology of the Cretaceous Aguja Formation (meet on the patio outside the café)

1:30 pm Paper session (in the bunkhouse beneath the Bad Rabbit Café)

6:30 pm Dinner for meeting registrants at the Bad Rabbit Café (meal available for attendees who did not preregister, $30.00)

Tuesday, May 210th

8:00 am Field trip to School of Constructive Arts (meet in the parking lot by the bath house)

8:30 am Geology stroll (meet on the patio outside the café)

8:30 am Field trip to Paisano Mine (meet in the parking lot outside the bunkhouse)

2:00 pm Afternoon paper session (in the bunkhouse beneath the Bad Rabbit Café)

6:30 pm Dinner for meeting registrants at the Bad Rabbit Café (meal available for attendees who did not preregister, $30.00)

Field Trips

Christmas Mountains Overlook
Trip leaders: Dave Lemke and Liz Measures
Monday morning at 8:00 – meet in the parking lot outside the bunkhouse

Participants will carpool up the summit road to a scenic overlook at the road's end. We will make several stops along the way to examine the geology and vegetation of the area and to take in views of the Rosillos Mountains and desert flats to the east and the Chisos Mountains to the southeast. The overlook, at an elevation of approximately 1640 m (5370 ft), provides stunning views of the region to the south and west, and participants will have the option of making the short but rugged hike to the summit at 1746 m (5728 ft).

Please note that the summit road requires short wheelbase, high-clearance vehicles with good tires and, consequently, the number of participants on this trip will be limited by the number of vehicles we have at our disposal.

Paleontology and Geology of the Alto Shale Member of the Aguja Formation (Cretaceous) Exposed East of the Terlingua Ranch Lodge
Trip leaders: Thomas Shiller, Sue Mulroney and Adam Myers
Monday morning at 8:00 – meet on the patio outside the Bad Rabbit Café

In 1939, a team of paleontologists from the American Museum of Natural History traveled to the region now known as Terlingua Ranch. During their visit, Dr. Erich M. Schlaikjer and William O. Sweet collected vertebrate fossil remains from the Cretaceous Aguja Formation near Smallpox Well. These included the left mandible, limb bones (one later found to be the radius of a duck-billed dinosaur), and other fragments from a small horned dinosaur, and a *Deinosuchus* tooth (formerly referred to as *Phobosuchus*). The collection localities lie just to the east of the Terlingua Ranch lodge, adjacent to property owned by Adam Myers and Susan Mulroney. Broad exposures of the Alto Shale member (formerly the upper shale member) of the Aguja Formation on the Myers/Mulroney property preserve a variety of vertebrate fossils (dinosaurs, turtles, and crocodilians) as well as fossil wood. A walk through the property will provide an opportunity to step back in time and observe rocks that formed when the landscape was strikingly different and discover the remains of plants and animals that lived over 65 million years ago.

School of Constructive Arts
Trip leader: Heather Christensen
Tuesday morning at 8:00 – meet in the parking lot outside the bath house

Join us for a tour of the School of Constructive Arts campus, located 20 minutes down the road from the Terlingua Ranch Lodge. The School of Constructive Arts is a field school teaching regenerative design, building, and ecology through direct observation, participation, and experimentation. Our approach integrates ancestral knowledge of natural materials and energy with advancing technology and contemporary building techniques to derive sustainable models of living for our time. We are

building facilities to support education, research, and experimentation and see our campus as a laboratory for direct study. In this tour we will show you around the facilities we have been building with our student programs and workshops, including a compressed earth block (CEB) aerobic composting outhouse, an earthbag shower building, and a CEB library with a traditional masonry bóveda vault. We will end our visit with a tour of the drylands restoration work we have started and talk through the strategy behind the recently planted Miyawaki food forest and greywater system that irrigates it.

Geology Stroll
Trip leader: Jim Chude
Tuesday morning at 8:30 – meet on the patio outside the Bad Rabbit Café

Join Jim Chude for a short hike to the overlook east of the headquarters area where he will provide an introduction to some of the major sedimentary rock formations and igneous intrusions that characterize the geology of the Christmas Mountains area. The hike will involve a short, mostly uphill trek over a gravel road and dirt path, as well as the possibility of some scrambling over open, rocky areas. This is a moderately easy hike, although since we are in the desert, plan to carry at least a liter of water with you.

Paisano Mine
Trip leader: Dave Lemke
Tuesday morning at 8:30 – meet in the parking lot outside the bunkhouse

Fluorspar or fluorite is an important industrial mineral used in the manufacture of steel, aluminum, glass, and fluorocarbons. It occurs at several localities in the Trans-Pecos and Llano regions of Texas. Trans-Pecos deposits are commonly associated with Tertiary volcanics and Cretaceous limestones. Occurrences of fluorspar have been found in the Quitman and Eagle Mountains of Hudspeth County, the Chinati Mountains of Presidio County, the Franklin Mountains of El Paso County, and the Christmas Mountains and other areas of Brewster County. None of the deposits in Texas are currently being produced.

The Paisano fluorite mine, covering an area of 310 hectares (766 acres) is located on the north side of the Christmas Mountains. This mining site was first discovered in 1971 and has been exploited through both surface and underground mining methods. The primary mining technique employed was open pit mining. By 1982, the mine had a capacity to extract 9 metric tons of ore per day, but the availability of lower cost fluorite from Mexico led to the closing of the mine in the 1980s.

We will carpool to a parking area near the mine site, which is then reached by a half-mile hike over a gravel road. This is a moderately easy hike, although since we are in the desert, plan to carry at least a liter of water with you

2025 CHRISTMAS MOUNTAINS RESEARCH SYMPOSIUM

Monday May 19

1:30 Introduction to the Christmas Mountains – a site for education and research
David E. Lemke, Texas State University

1:45 The bee fauna (Hymenoptera: Apoidea) of the Christmas Mountains Preserve, Brewster County, Texas
*John Pascarella and Jerry Cook, Sam Houston State University

2:00 An initial look at bird mortality from window collisions on the Sul Ross Alpine campus
Thornton Larson, Sul Ross State University

2:15 Break

2:30 Song dialects of the mountain chickadee (*Poecile gambeli*) in the sky islands of New Mexico
*Ben R. Skipper and Mary B. Anderson, Angelo State University

2:45 Pain and agony of bat detection
Lindsey Bredemeyer, Texas Master Naturalists

3:00 Transboundary occupancy of the American black bear: implications for southwest metapopulation dynamics between the U.S. and Mexico
*Jesse D. Ellgren, Caitlin M. Camp Pappas, Amanda M. Veals Dutt, Justin T. French and Louis A. Harveson, Sul Ross State University

3:15 Break

3:30 Outcompeting the invader: enhancing native species in Lehmann's lovegrass (*Eragrostis lehmanniana*) dominated rangelands
*Andres Solorio-Pulido, Carlos E. Gonzalez, Justin T. French, Jose S. Avila-Sanchez and Louis A. Harveson, Sul Ross State University

3:45 Testing Toyah terraces: Preliminary results of ongoing archeological investigations along the Rio Grande at Big Bend Ranch State Park
Tim Gibbs, Texas Parks and Wildlife Department

4:00 The School of Constructive Arts – Collaboration and experimentation in ecological restoration
Bob Estrin, *Heather Christensen and *Coakee Wildcat, School of Constructive Arts

Tuesday May 20

2:00 A survey of the bivalve (Unionidae) fauna of the Río Sabinas of northeastern Mexico
*César J. Rodriguez and Ned E. Strenth, Angelo State University

2:15 Current status of the Texas hornshell mussel (*Popenaias popeii*) in the Black River in New Mexico
*Austyn Chester, Matt Ramey, Matt Mathis and Emily Wirth, Center for Environmental Health, Monitoring, and Management

2:30 Providing evidence for effective conservation of Texas' groundwater-dependent invertebrates
*Kathryn Perez, Ben Hutchins and Benjamin Schwartz, University of Texas Rio Grande Valley and Texas State University

2:45 Break

3:00 The effects of ecotourism on groundwater resources in Brewster County, Texas
*Tina Neufeld and Kevin Urbanczyk, Sul Ross State University

3:15 Brewster County Groundwater Conservation District rules revisions
Kevin Urbanczyk, Sul Ross State University

3:30 Stream discharge estimates for Matonoso Creek, Presidio County, Texas
*Cole Payne and Kevin Urbanczyk, Sul Ross State University

3:45 Break

4:00 Dark for the Park: Novel energy industry efforts to preserve dark skies
Stephen Hummel, University of Texas McDonald Observatory

4:15 Scouting the skies: Remote seeing tests in the Christmas Mountains
*Alek Hutson, Philip Cole, Darrell Grissom, Joel Walker and Jerry Lin, Lamar University, Lamar Institute of Technology, and Sam Houston State University

ABSTRACTS

Monday Afternoon

Introduction to the Christmas Mountains – a site for education and research

David E. Lemke – Department of Biology, Texas State University, San Marcos, TX

This presentation will provide a brief overview of the geology, ecology, and history of the Christmas Mountains property from its inclusion as part of the massive G4 Ranch in the nineteenth century to its recent transfer to the Texas State University System. Geologically, the approximately 4000-hectare property is characterized largely by marine sedimentary rocks of Cretaceous age that have been intruded by much younger (44–40 million-year-old) igneous rocks forming a complex caldera system. At present, the area supports a desert grassland ecosystem comprising several distinct plant community types. The use of the property as an educational tool and the development of an on-site field srtation will also be discussed.

The bee fauna (Hymenoptera: Apoidea) of the Christmas Mountains Preserve, Brewster County, Texas

John Pascarella and Jerry Cook – Department of Biological Sciences, Sam Houston State University, Huntsville, TX

The bee fauna of the Christmas Mountains Biological Preserve was sampled from 2014–2022 using pan traps, blue vane traps, and sweep nets. Seven main sample sites were sampled from 2014–2017 ranging from the base of the mountain to the summit (1112–1636m). Across the entire study period, 12,030 bees were collected, representing six families (Andrenidae, Apidae, Colletidae, Halictidae, Megachilidae, and Melittidae). There were 1893 Andrenidae (15.7%), 28 Colletidae (0.23%), two Melittidae (0.02%), 5292 Halictidae (44%), 3560 Apidae (29.6%), and 1255 Megachilidae (10.4%). Bees were collected from March 05–October 30. The majority of specimens were female (10,115, 84.08%) while males constituted 1915 specimens (15.92%). Of all specimens, the majority were from pollen-collecting species (11,960 specimens, 99.4%) while cleptoparasitic bees only made up 69 (0.6%) specimens. The vast majority were native species (11,730, 97.5%), with only one non-native species, the honeybee, *Apis mellifera*, having a small number of specimens (299, 2.5%). The majority of specimens were collected via pan traps (68.2%), with 8202 specimens, followed by blue vane traps with 3444 specimens (28.6%) and a relatively small number via sweep nets (285, 2.4%); 99 were collected from both blue vane and pan without noting distinction.

There was a total of 52 genera of bees from six families, representing 205 species. Andrenidae had six genera and 40 species, Colletidae four genera and 10 species, Halictidae nine genera and at least 30 species, Melittidae one genus and one species, Apidae 21 genera and 71 species, and Megachilidae twelve genera and 53 species. A total of 1452 specimens could not be identified to species (88% identified). The majority of these were *Lasioglossum* subgenus *Dialictus* (1159, or 79.8% of all unidentified specimens), for which keys to Texas species are not yet developed. In addition, 190 *Melissodes*, 67 *Ashmeadiella*, 13 *Dufourea*, eight *Nomada*, six *Perdita*, three *Andrena*, two *Tetraloniella*, two *Sphecodes*, one *Epeolus*, and one *Triepeolus* were not determined. New state

records included *Calliopsis empelia*, *Pseudopanurgus vicinus*, *Centris transversa*, and *Diadasia martialis*. *Calliopsis anomoptera* is a new U.S. record, previously known from Ojinaga, Mexico, across the border from Presidio County, Texas.

An initial look at bird mortality from window collisions on the Sul Ross Alpine campus

Thornton Larson – Department of Natural Sciences, Sul Ross State University, Alpine, TX

Bird collisions with buildings in an urban landscape have long been a concern of naturalists and ornithological researchers. Rural and remote settings often do not see the same amount of attention regarding anthropogenic impacts on bird populations, including bird collisions with buildings. The United States is home to four main flyways that migratory birds migrate through between breeding and wintering habitats. Two of these flyways go through the state of Texas; one along the Gulf of Mexico and the other somewhat up the Rio Grande River and the few water patches near it. Initial anecdotal evidence has led to a systematic study to uncover the number of birds impacted and which species are most impacted. Through the use of systematic foot surveys three times a day around a majority of the main campus buildings we will uncover times of day, sides of building, species of birds most at risk for collisions. Here we will provide data collected from March to mid-May of 2025 of our ongoing research study. This research aims to inspire improvements that can be implemented in a targeted fashion to reduce bird impacts on the Sul Ross Alpine campus. This research will also highlight how large buildings in a rural environment affect bird mortality.

Song dialects of the mountain chickadee (*Poecile gambeli*) in the sky islands of New Mexico

Ben R. Skipper and Mary B. Anderson – Department of Biology, Angelo State University, San Angelo, TX

Isolated populations of a species may diverge in genetic or phenotypic traits if immigration among populations is low or absent. Among passerines that learn their songs by listening to singing members of their species, this can result in the formation of local or regional dialects. Dialect formation is especially strong in island systems where the matrix between islands in unsuitable for or blocks the passage of immigrants. Mountain chickadees (*Poecile gambeli*) in southwestern North America can be found in numerous mountain-top forest environments that have been termed sky islands and we hypothesized that isolated populations within a sky island system would exhibit distinct dialects with dialect similarity varying by distance. We quantified and compared the song dialects of mountain chickadees across three isolated mountain ranges in southeastern New Mexico, USA. Our results reveal each population to have a dominant dialect sung frequently by males in the population and that these three dialects are distinct from one another. Dialect similarity varied by distance with populations in close proximity being more similar than those further away. Our results suggest that movement of mountain chickadees among these three isolated mountain ranges is infrequent, and that each population may exist as an isolated population element.

Pain and agony of bat detection

Lindsey Bredemeyer – Texas Master Naturalists, Alpine, TX

Bats tend to be small creatures in a big dark sky beyond our natural night vision. Their songs are mostly beyond our range of hearing. While some take advantage of artificial light to concentrate insects, other species are very light and population avoidant. This occurs in a region known for being greatly under-researched, the Trans-Pecos. If that weren't enough, the Trans-Pecos has 27 bat species, 1.5 times the next largest Texas ecoregion and 3 times that of several other ecoregions. Bats are simply doing what they evolved to do. The problem is in the detection methodologies. Knowing the detection system is less important than knowing its limitations, whether that be sampling, analytic or targeting. This talk will document an engineer's experience with the pain and agony of bat detection.

Transboundary occupancy of the American black bear: implications for southwest metapopulation dynamics between the U.S. and Mexico

Jesse D. Ellgren, Caitlin M. Camp Pappas, Amanda M. Veals Dutt, Justin T. French and Louis A. Harveson – Borderlands Research Institute, Sul Ross State University, Alpine, TX

New border infrastructure across international boundaries has resulted in increased habitat fragmentation, as well as decreased population connectivity and gene flow in transboundary wildlife populations. These impacts have been documented in the United States, with particular impacts on large, far-ranging carnivore species. However, much is still unknown about impacts of U.S.–Mexico border infrastructure on large carnivores in Texas. The American black bear (*Ursus americanus*) is of particular interest for researchers and managers in the Texas borderlands. Since the first resident population of black bears returned to Big Bend National Park, Texas, in 1988, their range has slowly expanded over the last four decades. This has coincided with an increase in border infrastructure development along the U.S.–Mexico border. The bears in Texas are a part of a greater southwest black bear metapopulation (southwest Texas and northern Mexico) and are supplemented by bears moving northward from the Mexican states of Chihuahua and Coahuila. We deployed 50 trail cameras in a randomized design, with sampling grids at 4, 8, and 12 km distances from the Rio Grande River, across Val Verde, Kinney, and Maverick counties. Each randomly selected unit, evenly split among all distances, hosts a camera to estimate current black bear occupancy. We will model how black bear occupancy may be affected by additional biotic and abiotic factors to inform metapopulation dynamics and help managers prioritize movement corridors for long term population sustainability, while balancing international security.

Outcompeting the invader: enhancing native species in Lehmann lovegrass (*Eragrostis lehmanniana*) dominated rangelands

Andres Solorio-Pulido, Carlos E. Gonzalez, Justin T. French, Jose S. Avila-Sanchez, Louis A. Harveson – Borderlands Research Institute, Sul Ross State University, Alpine, TX

Non-native species like Lehmann lovegrass (*Eragrostis lehmanniana,* ERLE) were introduced to the

U.S. for erosion control and forage for cattle due to their resistance to drought, fire, and pests, making them highly adaptable to new environments. However, invasive plant species have a high capacity to spread and create monocultures, outcompeting native plant species (NPS) and reducing biodiversity, negatively impacting wildlife. This study aims to restore NPS and control Lehmann lovegrass in the Chihuahuan Desert. Research was conducted on Nine Point Mesa Ranch, Brewster County, Texas, across 200 plots, using the following treatments: seeding (S), soil disturbance (SD), and a combination of seeding and soil disturbance (SDS), plus controls (C). Data were collected over two years (2022–2024) using line intercept transects to measure vegetation cover. Results indicate that controls had more bare soil presence, and litter increased across treatments by winter 2023 and 2024. Plant diversity improved with S and SDS versus controls. Lehmann lovegrass is the second most abundant of 23 introduced species at the site. The redundancy analysis evaluated treatment effectiveness to achieve the project goal, showing relationships between treatments and species; in fall 2022 and winter 2022 and 2023 the relationships were positive for NPS and negative for Lehmann lovegrass across treatments while controls had more presence of the invader; in fall 2023 NPS and ERLE showed a positive relationship with S and SDS, the invasive kept its positive response with controls; in winter 2023 and 2024, Lehmann lovegrass showed positive response on controls and better response to SD, while NPS presented positive relationships with S and SDS. Overall, S and SDS allow NPS to have a balanced competition with the invader, even if it had a persistent invasive behavior.

Testing Toyah terraces: Preliminary results of ongoing archeological investigations along the Rio Grande at Big Bend Ranch State Park

Tim Gibbs – Big Bend Ranch State Park, Texas Parks and Wildlife Department, Lajitas, TX

With the recent discovery of well-preserved prehistoric cultural horizons along the Rio Grande, subsequent archeological testing has expanded the number of sites with potentially intact buried components present from four to six. This talk discusses recent findings from the second field season of the BBRSP River Corridor Testing Project, as well as potential implications on our understanding of the prehistoric archeology of the Big Bend.

The School of Constructive Arts – Collaboration and experimentation in ecological restoration

Bob Estrin, Heather Christensen and Coakee Wildcat – School of Constructive Arts, Terlingua, TX

The School of Constructive Arts is a field school teaching regenerative design, building, soil science, agroecology, and agroforestry through direct observation, participation, and experimentation. Current work is centered around evolving and strengthening our efforts to restore the health of the soil and plant communities in our region. Our approach combines ancient knowledge of ecological restoration with modern technology to create built spaces in which human activity enriches the diversity, health, and vitality of the land. Within the broader Big Bend area, our team has begun work with the Presidio Municipal Development District to produce a green infrastructure plan for the city that incorporates a thorough examination of the local patterns of vegetation and hydrology with the establishment of a tree nursery and community engagement events. Within our program, we have expanded our curriculum to dive deeper into soil science and ecology, along with exploring agroecology and

agroforestry as methods to enhance and accelerate the restoration of drylands soils and ecological succession on our campus. Our most recent student cohorts helped build a range of small-scale land and watershed restoration projects, including the planting of a small native food forest using the Miyawaki method of reforestation. The food forest is irrigated with greywater from our showers and outhouse and overflow from our water tank, and our goal is that it will be self-sustaining within 3 years. After this initial period of growth, we will expand the forest outward with the planting of more native trees and plants, with the goal of achieving a dense, mature community of trees and plants that will create and modulate a small local water cycle. To this end, we seek to position our efforts alongside regional conservation goals, and where possible work in collaboration with community and institutional partners on a shared vision of a regenerative future for the Big Bend.

Tuesday Afternoon

A survey of the bivalve (Unionidae) fauna of the Río Sabinas of northeastern Mexico

César J. Rodriguez and Ned E. Strenth – Department of Biology, Angelo State University, San Angelo, TX

On-site field collections conducted from 2004 through the fall of 2024 have recorded the presence of several species of bivalves from the Río Sabinas of northeastern Mexico. These include the Texas hornshell (*Poenaias popeii*), Texas lilliput (*Toxolasma texasense*), paper pondshell (*Utterbackia imbecillis*) and a possible subfossil species. While these collecting trips have produced shells of these species, no living specimens have been observed or collected. This current study was undertaken to examine the possibility of the application of more recently developed techniques to detect living populations of additional species using eDNA surveys. Water samples for eDNA analysis were taken from four sites on the Río Sabinas during the late summer and early fall of 2024. These sites were north of Múzquiz downstream (approximately 20 km) from the headwaters, San Juan de Sabinas, the impoundment within the municipality of Ciudad Sabinas, and a site midway between Cd. Sabinas and the Presa Don Martín reservoir. These samples are currently being processed by the Center for Biotechnology and Genomics Laboratory at Texas Tech University. Preliminary analysis indicated that approximately 38% of the water samples do in fact contain molluscan DNA. The results of these analyses will be presented as well as future field research surveys planned for the Río Sabinas.

Current status of the Texas hornshell mussel (*Popenaias popeii*) in the Black River in New Mexico.

Austyn Chester, Matt Ramey, Matt Mathis and Emily Wirth – Center for Environmental Health, Monitoring, and Management, Carlsbad, NM

The Texas hornshell (*Popenaias popeii*) is a small, freshwater mussel endemic to the Rio Grande Basin in New Mexico, Texas, and northern Mexico. They reside in rivers and streams, where they occupy crevices and stable substrates within undercut banks, preferring areas with stable flow and clean water. The species once occurred across a wide historic range. However, anthropogenic activities (e.g., impoundments, increased water use, energy development) have altered environmental conditions within their native habitats, leading to population declines and localized

extirpation events. With only five populations known in the United States, *P. popeii* was listed as federally endangered in 2018. As part of the Candidate Conservation Agreements and Candidate Conservation Agreements with Assurances program administered by the Center for Environmental Health, Monitoring, and Management, conservation initiatives are implemented to address threats and monitor the last remaining population of *P. popeii* occurring in New Mexico. Here we present a programmatic overview of these conservation initiatives and share results from collaborative research efforts aimed at investigating the ecology of *P. popeii* and environmental impacts to the population in the Black River. The results from these studies indicate that the Black River population is particularly vulnerable to reduced streamflow, elevated temperatures, and declining dissolved oxygen. Conservation of this population will rely on efforts that maintain flows at 0.26–0.38 m^3/s (9.3–13.4 cfs), temperatures below 28°C, dissolved oxygen levels above 1.5 mg/L, mitigate the impact of soil erosion, and provide for the persistence of suitable host fish species. Successful recruitment and population stability are entirely dependent on curbing the apparent loss of glochidia and juvenile life stages in this system. Ongoing efforts include implementing an instream flow program to increase and sustain river flows during critical periods to support *P. popeii* across all life stages. Additionally, long-term monitoring data is being used to identify and manage key microhabitats and locate areas where future translocation or reintroduction efforts could potentially aid in recovery.

Providing evidence for effective conservation of Texas' groundwater-dependent invertebrates

Kathryn Perez[1], Ben Hutchins[2] and Benjamin Schwartz[2,3] – [1]School of Integrative Biological and Chemical Sciences, University of Texas Rio Grande Vally, Edinburg, TX and [2]Edwards Aquifer Research and Data Center and [3]Department of Biology, Texas State University, San Marcos, TX

Groundwater ecosystems are under increasing pressure from human activities. Effective conservation requires understanding the biodiversity that is present, where they live, and how they make a living. Our work, with numerous collaborators and students, studies animals such as spring snails in Texas habitats that are underexplored to better understand the diversity of Texas' groundwater invertebrates. We will discuss some of our recent work studying Texas ciénegas, characterizing the invertebrate community and threats to determine which spring ecosystems across west Texas are the highest conservation priorities. We sampled for potentially vulnerable or imperiled invertebrates at 123 sites across the Trans-Pecos and western Edwards Plateau, identifying >156,000 invertebrates and used this information to reevaluate the conservation status rankings for 50 taxa. We found that insects and snails were the most imperiled, each with over 50% of taxa critically imperiled or extinct. Several sites in the northern Trans-Pecos and northwestern Edwards Plateau are experiencing spring failure or near spring failure due to groundwater extraction; this threat is present at half of the sites evaluated. The most severe and ubiquitous threat is climate change, which threatens groundwater flows via drought. The presence of extreme small-range endemics and/or high diversity of target taxa were used to identify 16 high conservation priority sites in the Trans-Pecos including springs along the Devil's River (Indian Springs, Big Satan, Finegan, Snake Springs, etc.), Caroline Springs, the Lower Canyons of the Rio Grande, and Sycamore Creek, along with isolated springs in the Big Bend Region.

The effects of ecotourism on groundwater resources in Brewster County, Texas

Tina Neufeld and Kevin Urbanczyk – Rio Grande Research Center, Sul Ross State University, Alpine, TX

Brewster County, located in far west Texas, is culturally and geologically complex with diverse habitats and attractions, featuring the towns of Alpine, Marathon, Terlingua, and Lajitas, as well as the Rio Grande and the Big Bend National and Big Bend Ranch State parks in the southern region of the county. Located within the Chihuahuan Desert, Brewster County receives approximately 43 cm (17 in) of precipitation annually. All public and private water supplies are sourced from the “igneous” aquifer and an unnamed Cretaceous aquifer. Via the Texas Water Development Board (TWDB) and the county's Groundwater Conservation District (GCD), enabled by the Texas Water Code Chapter 36, Brewster County is able to monitor and regulate its groundwater use.

With the rise in tourism in the county in recent years, there has been concern regarding long-term groundwater sustainability and availability. The population of the county is not projected to increase, but there is an evident increase in transient water users, presumably increasing transient groundwater consumption. Our research aims to estimate this increase in groundwater use through the Residential Gallons Per Capita Per Day equation developed by the TWDB, Texas Commission of Environmental Quality, and the Water Conservation Advisory Council. Using eCognition Object-Based Image Analysis and change-detection algorithms, we intend to conduct a longitudinal study to monitor the development of short-term rental properties in Terlingua and Lajitas. A qualitative study will also be conducted to gain insight into the local communities' perspective on groundwater use in the region. All these components will provide the Brewster County GCD with essential information about the undocumented increase in transient groundwater use.

Brewster County Groundwater Conservation District rules revisions

Kevin Urbanczyk – Rio Grande Research Center, Sul Ross State University, Alpine, TX

The Brewster County Groundwater Conservation District was established in 2001 to manage, conserve and protect groundwater resources while promoting sustainable development in the county. The district management consists of a board with seven directors, a manager and a student intern. Due to recent increases in visitation and in well drilling permit applications, the district is in the process of revising the district rules regarding well drilling. Most wells in the county fall in the ‘exempt’ category. Chapter 36 of the state water code defines an ‘exempt’ well to be a well on a property that is at least 10 acres in size and that will be used “solely for domestic use or for providing water for livestock or poultry” and is incapable of producing more than 25,000 gallons of groundwater per day (28 acre-feet per year). Many of the new requests for well drilling are for properties that are less than 10 acres. In the past, the 10-acre limit was typically waived. The draft version of the revised rules will still allow for wells to be drilled on these properties but they will not be considered exempt and they will have limits to water production and will require metering to document groundwater use. The limits on production are still to be defined, but they will be significantly lower than the current 28 acre-feet per year.

Stream discharge estimates for Matonoso Creek, Presidio County, Texas

Cole Payne and Kevin Urbanczyk – Rio Grande Research Center, Sul Ross State University, Alpine, TX

Matonoso Creek is a tributary to Alamito Creek south of Marfa in Presidio County, Texas. The catchment is 6,617 hectares with a channel length of 32 km. We used 1 m digital elevation models (DEM), ArcGIS Pro and Python scripting to assess the channel conditions in the creek and to estimate discharge at various locations along the channel. The ArcGIS Pro component created cross section graphs and contributing areas for specific locations along the channel. After visual analysis of the cross sections, Python code was used to determine the discharge at selected cross sections using estimated water surface elevations based upon cross section shape and visual identification of bank full stage. Manning's equation was used for this step. The results will be used to assist in restoration projects designed to minimize channel erosion and to increase sediment deposition.

Dark for the Park: Novel energy industry efforts to preserve dark skies

Stephen Hummel – The University of Texas McDonald Observatory, Ft. Davis, TX

Dark night skies are a major draw for both visitors and academics to the Big Bend region. The largest source of skyglow, or light pollution, in far west Texas is oil and gas activity in the Permian Basin. McDonald Observatory has previously partnered with multiple oil and gas operators in Texas to implement responsible lighting practices that balance safety and dark skies preservation for mutual benefit. However, only half of the Permian Basin lies within Texas. The New Mexico portion of the basin has seen heightened activity in recent years and is a growing source of skyglow especially for Guadalupe Mountains and Carlsbad Caverns national parks, and contributes to skyglow observable as far south as Big Bend National Park. To address this problem, McDonald Observatory partnered with the New Mexico Oil and Gas Association, the National Park Service, and others to form the Dark for the Park Alliance with the goal of reducing skyglow in the Permian Basin. A pilot project to implement newly updated outdoor lighting guidelines at several oil and gas facilities owned by Franklin Mountain Energy has resulted in large relative reductions in skyglow, reduced operating costs, and adherence to all relevant safety standards. The results serve as a model for other industrial facilities.

Scouting the skies: Remote seeing tests in the Christmas Mountains

Alek Hutson[1], Philip Cole[1], Darrell Grissom[2], Joel Walker[3] and Jerry Lin[4] – [1]Department of Physics, Lamar University, Beaumont, TX, [2]Department of Technology, Lamar Institute of Technology, Beaumont, TX, [3]Department of Physics and Astronomy, Sam Houston State University, Huntsville, TX, and [4]Department of Civil Engineering, Lamar University, Beaumont, TX

The Christmas Mountains offer some of the darkest skies in Texas, but how stable are those skies night after night, and how do we determine the best location for astronomical observations? Over the past year we placed a small "Cyclope" (starlight monitor) at the "Bare Bones" location and let it run unattended, sending its nightly logs remotely through a basic FTP server. By tracking how much the stars twinkle, a simple proxy for atmospheric turbulence, we built a month-by-month map of sky

steadiness. Our readings confirm that the Christmas Mountains' dark sky lets in plenty of starlight, yet the views from our lower-elevation site are rarely as crisp as we would like. We believe fine desert dust and other particulates settle in the valleys and scatter the light, softening stellar images even on clear nights. The takeaway is clear: moving the instruments higher, where the air is cleaner and steadier, will give a future telescope the sharp vision it needs. Just as important are the hard-won lessons from running delicate optics in a harsh desert. In this environment we deal with dust, wind, wide temperature swings, wildlife, and fickle rural internet. Some fixes were straightforward while others took trial and error. The talk will walk through these pitfalls and the practical workarounds so future teams can skip the false starts.

Looking ahead, we plan to deploy three more monitors at higher elevations once easement permission is granted. The expanded network will let us compare conditions at different sites impacted by varying microclimates and nail down the best spot for a 1.5-meter remotely operated telescope, while refining the remote-access workflow for multiple instruments. With the results of our "Cyclope" data we hope to establish optimal placement for astronomical observations while informing dark-sky stewardship. These results could also reveal how light, or its welcome absence, affects local biodiversity. Finally, our efforts offer a blueprint for collecting quality sky data, along with a candid look at what can go wrong when technology meets wilderness.

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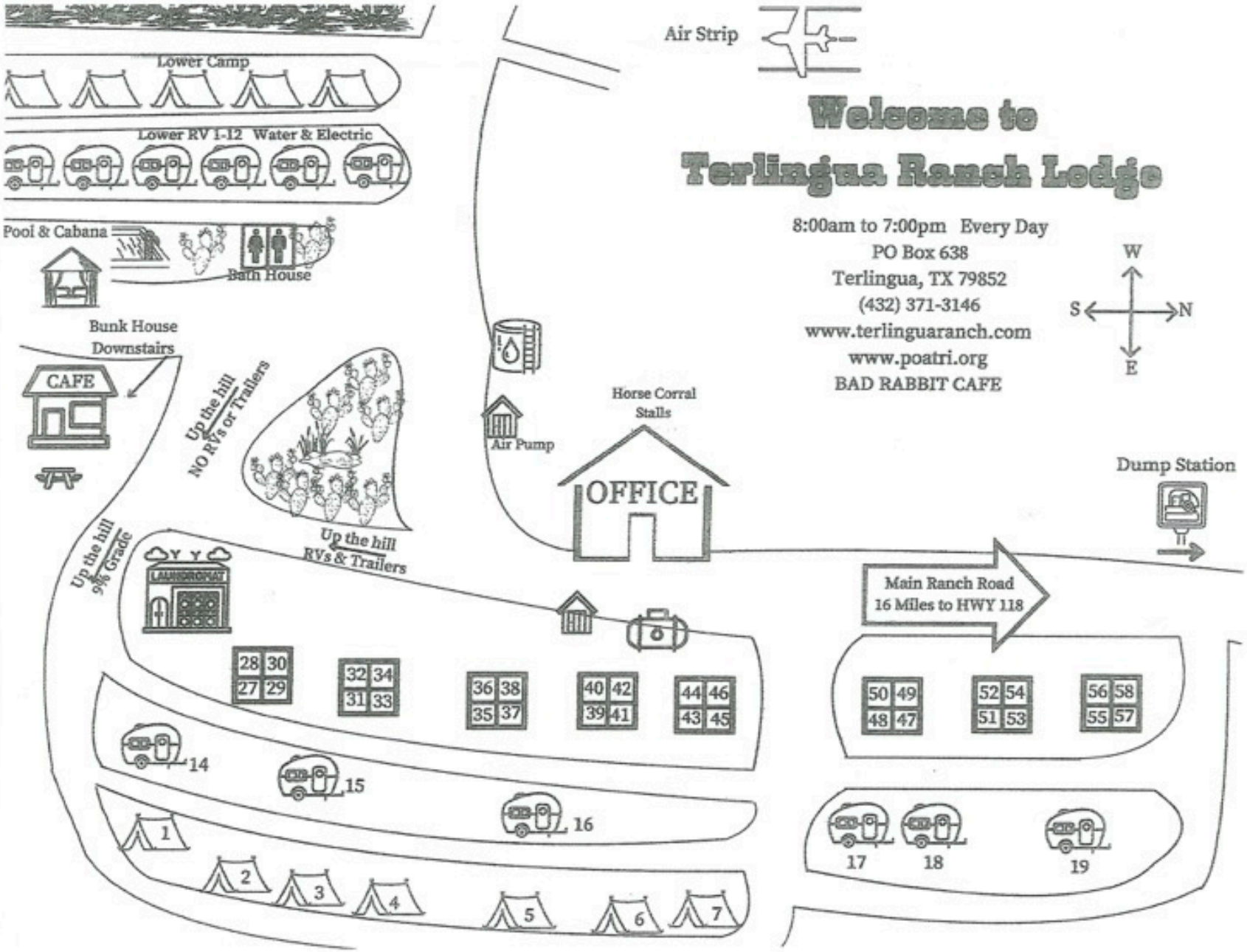
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CHRISTMAS MOUNTAINS RESEARCH SYMPOSIUM 2026

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May 17–19, 2026

Front cover illustration: In the Big Bend region, few birds stand out as brightly as the male Scott's Oriole (*Icterus parisorum*) with its rich lemon-and-black plumage. This gifted and frequent singer, named for nineteenth century U.S. Army general Winfield Scott, inhabits deserts and the mountain slopes adjacent to them, where it nests and forages in tall yuccas, junipers, and pinyon pines, restlessly moving about in pairs or small groups in search of invertebrates, nectar, and fruit. It is particularly closely associated with yuccas, where it forages for insects and nectar and gathers fibers for its nests, which frequently hang from live yucca leaves. Original photo taken by S. Hanson at Terlingua Ranch.